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INTERRELATIONSHIP AND CAUSE-EFFECT ANALYSIS OF RICE GENOTYPES IN NORTH EAST PLAIN ZONE

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ABSTRACT

A study of interrelationship and cause-effect analysis of grain yield and its component traits was carried out using thirty one rice genotypes. Grain yield per plant had significant positive correlation with biological yield per plant (0.92), plant height (0.66), number of spikelets per panicle (0.64), panicle length (0.61), flag leaf length (0.61), flag leaf width (0.52) and days to 50% flowering (0.32). Path analysis revealed that the biological yield was the major contributor of grain yield per plant followed by number of spikelets per panicle and test weight. It can be concluded that higher biological yield (0.68), number of spikelets per panicle (0.17) and test weight (0.96) are important plant traits which should be considered when any breeding program for higher paddy yield in rice is to be planned.

INTRODUCTION

The basic objective of most of the crop improvement programs is to realize a marked improvement in crop yield. But yield is a complex character which is controlled by association of various characters. Before placing strong emphasis on breeding for yield improvement trait, the knowledge on the association between yield and yield attributes will enable the breeder in the improvement of yield. The correlation coefficient may also help to identify characters that have little or no importance in the selection programme. The existence of correlation may be attributed to the presence of linkage or pleiotropic effect of genes or physiological and development relationship or environmental effect or incombination of all (Oad *et al.,* 2002).The information on association of yield attributes and their direct and indirect effects on grain yield are of paramount significance. Hence, path analysis is of much importance in any plant breeding program.

Path analysis is that, it permits the partitioning of the correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable upon its response variable; the second component being the indirect effect(s) of a predictor variable on the response variable through another predictor variable (Dewey and Lu, 1959). In agriculture, path analysis has been used by plant breeders to assist in identifying traits that are useful as selection criteria to improve crop yield (Milligan *et al.,* 1990; Surek and Beser, 2003). The present research study was conducted to find out the genetic variability among different plant traits, direct and indirect contribution of these parameters towards paddy yield and to identify better combinations as selection criteria for developing high yielding rice genotypes.

MATERIAL AND METHODS

The present experiment was carried out at experimentation center of the Department of Genetics and Plant Breeding, Allahabad school of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India, situated at 25.87°N Latitude, 81.5°E Longitude and altitude of 78 meters above mean sea level. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The experimental material was planted in three blocks. Each block consisted of thirty one genotypes randomized and replicated within each block. Twenty seven days old seedlings were transplanted 20 cm apart between rows and 15 cm within the row. All necessary precautions were taken to maintain uniform plant population in each treatment per replication. All the recommended package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded and the data was subjected to statistical analysis. Statistical analyses for the above characters were done following Singh and Chaudhary (1985) for correlation coefficient and Dewey and Lu (1959) for path analysis.

RESULTS AND DISCUSSION

Selection based on the detailed knowledge of magnitude and direction of association between yield and its attributes is very important in identifying the key characters, which can be exploited for crop improvement through suitable breeding programme. Phenotypic and genotypic correlations between yield and yield components viz., days to 50 per cent flowering, plant height, flag leaf length, flag leaf width, panicle length, number of panicles per plant , number of spikelets per panicle and 1000 grains weight were computed separately for rice genotypes. The results are presented in Table 1. The results revealed that the estimates of genotypic coefficients were higher than phenotypic correlation coefficients for most of the characters under study which indicated strong inherent association between the characters which might be due to masking or modifying effects of environment.

Days to 50 per cent flowering registered strong and positive significant correlation with number of spikelets per panicle, days to maturity and grain yield per hill, while negative association with number of tillers per hill and number of panicles per hill.This corroborates with the findings of Reddy *et al.,* (2008), Babu *et al.,* (2006) and Saravanan and Sabesan (2009) for days to maturity.The association expressed by plant height with flag leaf length, flag leaf width, biological yield per hill, number of spikelets per panicle and panicle length was significant and positive at both levels (Table 1). It suggests that, priority should be given to these traits while making selection for yield improvement. A similar result for plant height association with panicle length was reported by Eradasappa *et al.,* (2007) and Jayasudha and Sharma (2010). The correlation of number of spikelets per panicle exhibited positiveand significant association with panicle length and biological yield per hill. Similar results were reported by Seyoum *et al.,* (2012).

Biological yield per hill, plant height, number of spikelets per panicle, panicle length, flag leaf length had strong and positive significant association with grain yield per plant. It indicated that grain yield can be increased whenever there is an increase in characters that showed positive and significant association with grain yield. Hence, these characters can be considered as criteria for selection for higher yield as these were mutually and directly associated with yield. The correlation coefficient showed biological yield per hill serves as important selection indices of grain yield. Kole *et al.,* (2008) emphasized the importance of biological yield per hill in determining grain yield in rice. Chakraborty and Chakraborty (2010), Hossain and Hoque (2003), Singh *et al.,* (2002) and Biswas *et al.,* (2000) reported positive significant association of panicle length with grain yield per plant. The positive significant of number of spikelets per panicle with yield was supported by Mustafa and Elsheikh (2007). Plant height revealed significant

Table 1: Genotypic (G) and phenotypic (P) correlations for various characters in Rice

Character		Days to 50% flowering	Plant height cm	Flag leaf length cm	Flag leaf width cm	Tillers/ hill	Panicles/ hill	Panicle length cm	Spikelets/ panicle	Biological yield/ hill	Days to maturity	Test weight	harvest Index	Economic yield/hill
Days to 50%	G	1.0000	0.0939	0.2844**	0.1858	-0.1324	-0.0122	0.2317*	0.3530***	0.2464*	0.9968***	0.0565	-0.0323	0.3320**
flowering	P	1.0000	0.0996	0.2796**	0.1865	-0.1247	-0.0158	0.2333*	0.3510***	0.2550*	0.9818***	0.0601	0.0075	0.2991**
Plant	G		1.0000	0.6938***	0.5303***	0.0012	0.0035	0.7754***	0.554***	0.6879***	0.0938	0.2237	-0.2437	0.6633***
height cm	P		1.0000	0.6796***	0.5279***	0.0043	0.0031	0.7656***	0.5533***	0.6561***	0.1011	0.2245*	-0.1321	0.6051***
Flag leaf	G			1.0000	0.6307	0.1078	0.0591	0.7675***	0.6089***	0.7294***	0.2994**	0.2115*	-0.4004**	0.6167***
length cm	P			1.0000	0.6188	0.1072	0.0569	0.7477***	0.5933***	0.6610***	0.2985**	0.2047*	-0.2587**	0.5474***
Flag leaf	G				1.0000	0.3878***	0.2727**	0.6380***	0.5675***	0.5201***	0.1879	0.1568	-0.2491	0.5220***
width cm	P				1.0000	0.3874***	0.2688**	0.6264***	0.5651***	0.4931***	0.1884	0.1549	-0.1437	0.4758***
Tillers/ hill	G					1.0000	0.8711***	0.0462	-0.0881	0.1408	-0.1097	-0.0782	-0.2590	0.0580
	P					1.0000	0.8629***	0.0500	-0.0865	0.1427	-0.1001	-0.0726	-0.1440	0.0616
Panicles/hill	G						1.0000	0.0002	-0.0416	0.2739*	0.0157	-0.1616	-0.2595	0.1860
	P						1.0000	-0.0051	-0.0430	0.2457*	0.0125	-0.1611	-0.1691	0.1637
Panicle	G							1.0000	0.6874***	0.6309***	0.2186*	0.2426*	-0.3174	.6107***
length cm	P							1.0000	0.6799***	0.6125***	0.2274*	0.2465*	-0.1510	0.5597***
Spikelets/	G								1.0000	0.5552***	0.3720***	-0.1697	0.0204	.6413***
panicle	P								1.0000	0.5338***	0.3671***	-0.1639	0.0274	0.5781***
Biological	G									1.0000	0.2557**	0.0477	-0.5299*	0.9224***
yield/ hill	P									1.0000	0.2619**	0.0682	-0.2054*	0.7988***
Days to	G										1.0000	0.0202	-0.0546	0.3192**
maturity	P										1.0000	0.0289	0.0144	0.3111**
Test weight	G											1.0000	-0.0252	0.1179
	P											1.0000	0.0147	0.1149
Harvest Index	G												1.0000	0.1021
	P												1.0000	0.0842
Economic	G													1.0000
yield/ hill	P													1.0000

Table 2: Genotypic path coefficient showing direct and indirect effects of different characters on Grain yield

Character	Days to 50% flowering	Plant height cm	Flag leaf length cm	Flag Leaf width cm	Tillers/ hill	Panicles/ hill	Panicle length cm	Spikelets/ panicle	Biological yield/ hill	Days to maturity	Test weight	Harvest index
Days to 50% flowering	-0.1243	-0.0124	-0.0348	-0.0232	0.0155	0.0020	-0.0290	-0.0436	-0.0317	-0.1220	-0.0075	-0.0009
Plant height cm	0.0109	0.1091	0.0741	0.0576	0.0005	0.0003	0.0835	0.0604	0.0716	0.0110	0.0245	-0.0144
Flag leaf length cm	-0.0154	-0.0374	-0.0551	-0.0341	-0.0059	-0.0031	-0.0412	-0.0327	-0.0364	-0.0164	-0.0113	0.0142
Flag leaf width cm	0.0133	0.0377	0.0442	0.0714	0.0276	0.0192	0.0447	0.0403	0.0352	0.0134	0.0111	-0.0103
Tillers/hill	0.0150	-0.0005	-0.0129	-0.0466	-0.1204	-0.1039	-0.0060	0.0104	-0.0172	0.0120	0.0087	0.0173
Panicles/hill	-0.0022	0.0004	0.0080	0.0379	0.1217	0.1411	-0.0007	-0.0061	0.0347	0.0018	-0.0227	-0.0239
Panicle length cm	-0.0116	-0.0381	-0.0372	-0.0311	-0.0025	0.0003	-0.0497	-0.0338	-0.0305	-0.0113	-0.0123	0.0075
Spikelets/panicle	0.0582	0.0917	0.0983	0.0936	-0.0143	-0.0071	0.1127	0.1657	0.0885	0.0608	-0.0272	0.0045
Biological yield/hill	0.1728	0.4446	0.4479	0.3341	0.0967	0.1665	0.4151	0.3617	0.6776	0.1775	0.0462	-0.1392
Days to maturity	0.1750	0.0180	0.0532	0.0336	-0.0178	0.0022	0.0405	0.0654	0.0467	0.1782	0.0052	0.0026
Test weight	0.0058	0.0217	0.0198	0.0150	-0.0070	-0.0156	0.0239	-0.0159	0.0066	0.0028	0.0968	0.0014
harvest index	0.0017	-0.0298	-0.0583	-0.0324	-0.0324	-0.0381	-0.0340	0.0062	-0.0463	0.0032	0.0033	0.2253
Economic yield/hill	0.2991	0.6051	0.5474	0.4758	0.0616	0.1637	0.5597	0.5781	0.7988	0.3111	0.1149	0.0842

positive correlation with yield which was supported the results of Bhadru *et al.,* (2011).

Negative significant correlation was observed between harvest index with flag leaf length and biological yield per hill at both genotypic and phenotypic levels. Similar negative correlation was also reported by Kole *et al.,* (2008). The genetic reasons for this type of negative association may be linkage or pleiotropy. According to NeWall and Eberhart (1961) when two characters show negative phenotypic and genotypic correlation it would be difficult to exercise simultaneous selection for these characters in the development of a variety. Hence, under such situations, judicious selection programme might be formulated for simultaneous improvement of such important developmental and component characters.

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. It allows separating the direct effect and their indirect effects through other attributes by apportioning the correlations (Wright, 1921) for better interpretation of cause and effect relationship. The estimates of path coefficient analysis are furnished for yield and yield component characters in Table 2. Among all the characters, biological yield per hill had the maximum positive effect on grain yield followed by harvest index, days to maturity and number of spikelets per panicle. Positive direct effects of these traits on grain yield indicated their importance in determining this complex characterand therefore, should be kept in mind while practicing selection aimed at the improvement of grain yield. These findings were also corroborated by Kole *et al.,* (2008)and Sarawgi *et al.,* (2000) On the other hand, negative direct effect on grain yield were recorded by flag leaf length, panicle length and number of tillers per hill as suggested by Sarawagi *et al.,* (2000), Reuben and Katouli (1989), Zahid *et al.,* (2006) and Nandan *et al.,* (2010).

Plant height expressed indirect positive effect on grain yield per plant through flag leaf width, number of panicles per hill, number of spikelets per panicle, biological yield per hill and 1000 grain weight. The indirect expression of panicle length on grain yield through all the foresaid characters were negative except number of panicles per hill which was positive. Days to maturity expressed indirect positive effect on yield per plant through all characters except number of tillers per hill. The indirect expression of flag leaf width on yield per plant through all characters was positive except harvest index. The indirect expression of number of spikelets per panicle on grain yield per plant through plant height, flag leaf length, flag leaf width and biological yield per hill had a positive effect. 1000 grain weight expressed positive indirect effect on yield per plant through plant height, flag leaf length, flag leaf width, biological yield per hill and days to maturity.

Based on the studies on correlation and path-coefficient analysis, it may be concluded that, biological yield per hill, harvest index and number of spikelets per panicle exhibited maximum positive direct effect on grain yield seems to be primary yield contributing characters and could be relied upon for selection of genotypes to improve genetic yield potential of rice. Hence, utmost importance should be given to these characters during selection for single plant yield improvement. Similar results had been reported by Ekka *et al.,* (2011).Selection of plants on the basis of these traits would certainly lead to improvement in grain yield.

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